SPIRE VARIATION IN *PYRAMIDULA ALTERNATA*.

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I. INTRODUCTION.

THE object of the present investigation has been to ascertain by quantitative means the amount of variation in the same species of a pulmonate mollusk from several localities. For this purpose the shell of the common species, *Pyramidula alternata*, has been selected, as that species shows a large amount of variation in the form of the shell, particularly in the height of the spire.

Among the mollusks little biometric work was done previous to the year 1898. Since that time this group of animals has been receiving marked attention and several exhaustive papers have been published, notably those by C. C. Adams on Io and C. B. Davenport on Pecten. These papers, however, have dealt with marine or fresh water forms; in this investigation the biometric study has been applied to an air breathing land mollusk.

II. MATERIAL.

The material used in this investigation, *Pyramidula alternata* Say, was secured from the following localities:

1. Rochester, New York, on the steep hillside of the "Pinnacle" and the banks of the lower Genesee River. This locality is heavily wooded and there is a large accumulation of fallen logs and the ground is covered by a rich, black loam. Collected by the writer.

2. Auburn, New York, in damp, low, flat woodlands. Collected by Dr. Howard N. Lyon.

3. Bowmanville, near Chicago, Illinois, in flat woodlands. The timber is large and heavy, the ground is strewn with fallen

logs and the soil is a rich, black loam. Collected by the writer. The shells studied are not of uniform size, although they are nearly all adult measuring from twelve to twenty-four millimeters in diameter. The young shells of this species always have a flat or nearly flat spire, and as they would materially affect the results they were excluded.

In *Pyramidula alternata* we find a good example of variation caused by individual environment. The species lives for the most part under started bark, in crevices and under flat-lying tree trunks; hence its shell varies with its abode. For example, a specimen living between the "started" bark of a tree and the tree trunk, the space being very narrow, measured 23 × 11 mill., the height being about 48 per cent. of the width, while another specimen living under a fallen tree trunk measured 15 × 13 mill., the height being about 87 per cent. of the width, or 39 per cent. more than the first example. These specimens were from the same locality and from adjacent trees. Their habit of crowding into narrow crevices and between the bark and the tree trunk has caused this species to become one of the most variable of land shells as regards the form of the shell.[1]

On account of the extreme variability it was thought that a quantitative study of material from several rather widely separated localities would produce results of some interest. This species has a wide geographic range, being found throughout the eastern and central parts of the United States and Canada. Its western limit is said to be Minnesota.

III. METHOD OF OBTAINING QUANTITATIVE DATA.

To obtain a variation index the diameter and altitude of the shell was measured in millimeters and the altitude divided by the diameter; *i. e.*, $\frac{\text{altitude.}}{\text{diameter}}$ The per cents. obtained in this way provide the shell index. In the diagrams the individuals or classes having the same per cent. are indicated on the horizontal line and the number of specimens in these classes (the frequencies) are indicated on the vertical line.

[1] See *Nautilus*, Vol. 10, p. 63, for a good article on this subject by C. C. Ormsbee on "Influence of Environment upon the Form and Color of Helix alternata."

The number of specimens available for this study has not been as large as is desirable in investigations of this kind; but as the three lots are of about the same number the results will not be materially affected.

In the tables of data the per cents. are indicated by a numerator and the individuals or frequencies having the same per cent. is noted as a denominator.

IV. Discussion of Data.

The Rochester Shells.

Figure 1.

The shells from Rochester show a rather wide range of variation, as is seen in Fig. 1, which is strongly trimodal. The most

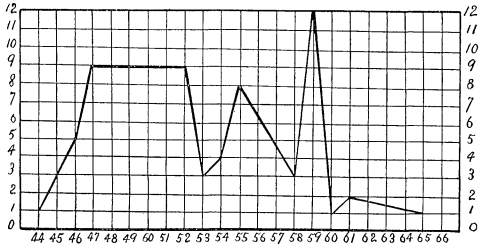

Fig. 1.— Rochester shells. Variation curve of 67 specimens.

peculiar aspect of this curve is the broad mode from 47 to 52 per cent., the frequencies being 9. The two sharp modes are 55 with a frequency of 8 and 59 with a frequency of 12. The variation is from 44 to 65 per cent. The data for Fig. 1 is shown in Table A.

Table A.

44	46	47	50	52	53	54	55	58	59	60	61	65
1	5	9	9	9	3	4	8	3	12	1	2	1

The number of shells examined was 67.

The Auburn Shells.

Figure 2.

The Auburn shells are not as variable as those from Rochester, a fact shown by the greater regularity of the curve, which

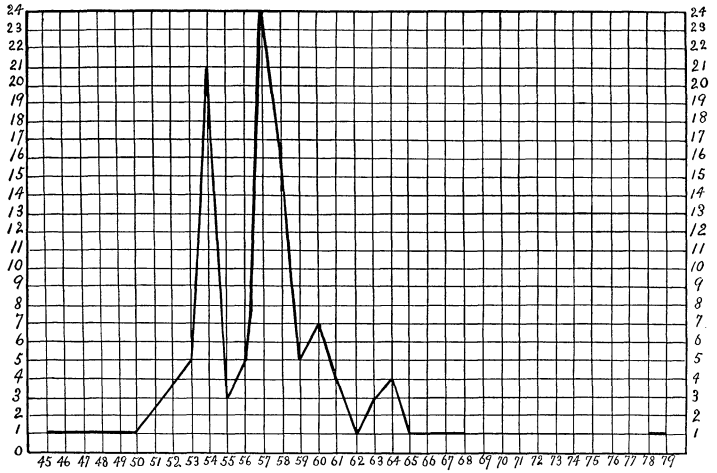

FIG. 2. — Auburn shells. Variation curve of 104 specimens.

is practically bimodal, the minor mode being at 54 per cent. with a frequency of 21 and the major mode at 57 with a frequency of 24. The data for this curve is shown in Table B.

Table B.

45	50	53	54	55	56	57	58	59	60	61	62	63
1	1	5	21	3	5	24	16	5	7	4	1	3

64	65	66	68	79
4	1	1	1	1

The number of shells examined was 104. The range of variation is from 45 to 79 per cent.

The Bowmanville Shells.

Figure 3.

The Bowmanville shells are the most variable of the three lots, the curve showing a marked multimodal tendency, which

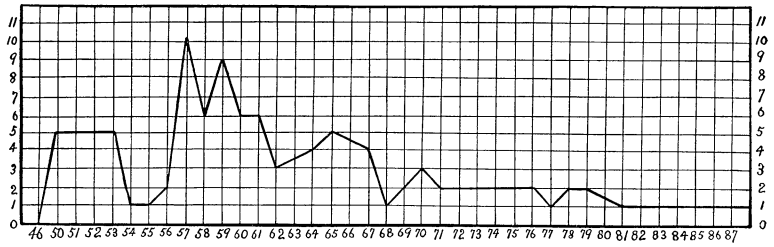

FIG. 3. — Bowmanville shells. Variation curve of 85 specimens.

always stands for extreme variability. The range of variation is from 46 to 87 per cent. There are four modes of prominence, at 50–53, 57, 59 and 65, with frequencies of 5, 10, 9 and 5, respectively. It will be noted that the curve for the Bowmanville shells is very similar to that of the curve for the Rochester shells, the peculiar broad mode being present in each. The data for this curve is shown in Table C.

Table C.

46	50	53	54	55	56	57	58	59	60	61	62	64
1	5	5	1	1	2	10	6	9	6	6	3	4

65	67	68	70	71	72	76	77	78	79	81	87.
5	4	1	3	2	2	2	1	2	2	1	1

The number of specimens examined was 85.

V. COMPARISON OF THE THREE LOCALITIES.

Figure 4.

In comparing the three localities it will be noted that the Bowmanville and Rochester shells resemble each other very

closely in the form of their curves, which is quite different from

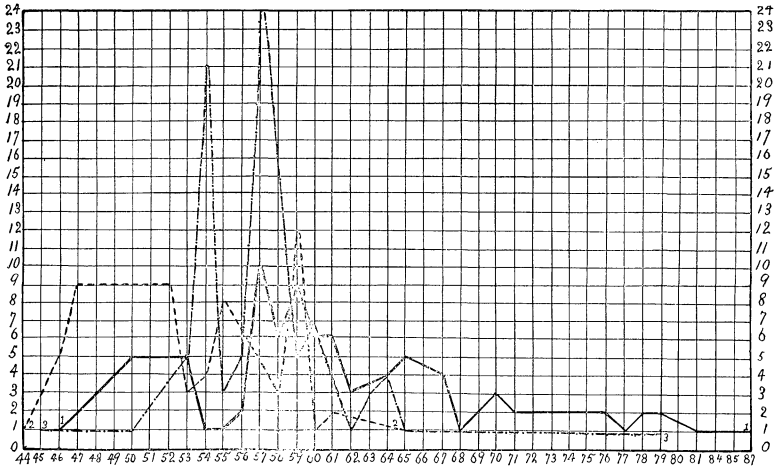

FIG. 4. — Comparison of the three localities. 1. Bowmanville. 2. Rochester. 3. Auburn.

the Auburn curve, which is very symmetrical, showing a smaller amount of variation. The major mode for the three localities is about the same, standing as follows:

Bowmanville	57 %.[1]
Rochester	59 %.
Auburn	57 %.

The mean per cent. for the three localities is as follows:

Bowmanville	65.1 %.
Auburn	59.7 %.
Rochester	54.1 %.

This shows that the Bowmanville shells have relatively the highest spires, while the Rochester shells have the lowest spires. The widest variation is found in the Bowmanville shells, where the extremes are 46 and 87 per cent.

[1] 100% would mean that the diameter and height were the same; hence the per cent. shows the relation of height to diameter.

Geographically the western shells show a wider range of variability than do the eastern shells. With one exception (Auburn 79%) the eastern shells have the per cent. of spire elevation between 44 and 68, while those from the west range between 46 and 87, the per cents. between 68 and 81 being numerous.

One of the most noticeable features in the curves as plotted in this paper is their tendency to assume a multimodal form. This is clearly shown in the individual diagrams, but stands out prominently in the comparison of the localities (Fig. 4). This is, of course, indicative of great variability.

From the study of these three lots of shells we may conclude that the western *alternata* has a higher shell, on the average, than does the eastern form, and that it shows a much larger amount of variation in spire elevation. It would be very interesting to have curves plotted from other localities, east and west, to ascertain whether their results would coincide with the conclusions of the present paper.

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[1] This bibliography contains some of the more important papers bearing on the variation of the Mollusca, from a biometric standpoint; the list is not exhaustive.

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